Modeling Remodeling

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I. Introduction

The housing market is the most important non-human asset for a majority of Americans. Housing and Urban development secretary Andrew Cuomo was quoted in the San Francisco Chronicle in the year 2000 saying that "home ownership rates had risen to 67.7 percent." This was a record percentage of people owning a home. Most home owners usually count their personal residence as their most valuable asset. The home market takes on great importance for this reason.

The most widely studied parts of the housing market are the factors that move supply and demand for new and used homes (Engelhardt and Poterba 1990; Green and Hendershott 1995; Hamilton 1990; Hendershott 1990; Mankiw and Weil 1989; Woodward 1991). A much less studied section of the housing market is the home remodel market. The National Association of Home Builders list the size of the home remodel market as $153 billion (Freeman). New home construction is widely studied and quoted yet the market is only about twice as big at $ 300 billion (Greenspan). The remodel market is big enough to deserve more attention. Literature on the remodel market is mostly limited to the popular press (exceptions include Baum and Hassan 1999). An intriguing series of articles has appeared in Realtor Magazine. Every year Realtor Magazine estimates the net market return given by particular jobs (2002 Cost versus Value). For example in 2002 Realtor magazine estimated that a bathroom addition in the city of Seattle would return 93 percent of the cost in market value (Appendix A1 contains the data for a typical addition and a typical interior remodel). They obtain their data from

an opinion survey of real estate agents and contractors. Several fascinating puzzles arise from this data.

The Realtor magazine tables suggest that in almost every city in the country the amount added to the market value by a home remodel is less than the cost of the construction. If homeowners are sufficiently informed about the likely benefits to their remodel why would they undertake a remodel that has negative net financial returns? There seems to be two possible answers to this quandary. The first possibility is that Realtor magazine is incorrect in its valuation of remodeling projects. This is a definite likelihood considering the incentives a real estate agent would have in evaluating the return on remodeling. Real estate agents make their living by the sale of homes. It would be in a real estate agent's best interest to underestimate the returns to remodel to increase the attractiveness of buying a new home. Renovators could also simply be wrong when estimating the returns to remodeling. However, the results from Realtor magazine suggest that they are consistently wrong. It would have to be assumed that remodelers were always misinformed or too stupid to catch on that a remodel was not going to return more than the cost. The other option is the decision to remodel is a function of net financial returns plus some other factors.

The data I have gathered will suggest that Realtor magazine is not wrong in its estimations of remodel job returns. Many renovations have negative net financial returns. However, remodeling becomes an attractive option for homeowners because of the costs of moving. The costs of moving are tied to an individual homeowner's expected time to next move.

The information for this project is collected from building permits and assessor's data. The building permits are from the cities of Seattle and Everett. Assessor's data comes from King and Snohomish County.[1]

The next section of the paper puts forth a general theory of home remodeling. Section III describes the tests that are performed to substantiate the theory. The methods and data used are then explained in Section IV. Section V then presents the results of the data. The paper then concludes with a discussion of what the results mean and why they are important.

II. Theory

How does a homeowner decide if they want to undertake a remodel? A renovator will only undertake a remodel if the total net benefits are positive. Realtor magazine classifies remodels based upon their net returns in market value. The presence of many negative market return jobs suggests that there might be other factors that determine net benefit beyond monetary returns. These other factors are the opportunity-cost of remodeling in the homeowner's time, the transaction costs of moving, the advantages of not moving, and the non-monetary benefits of the remodel.

Opportunity cost of remodeling refers to the loss incurred by the remodel. Remodels generally take time to plan and construct. Also, renovating usually decommissions part of the home. These costs are not included in the Realtor Magazine's cost estimates. The time and physical space occupied during the renovation process could have been used in other ways. The opportunity cost will rise as more time and home value are spent on the remodel. Both the time it takes to plan and the length of

[1] All the data had to be reconciled with each other to make any sense. This was by far the most time consuming part of the research. For a full discussion of the process that had to be done see Appendix A4

construction process are not in the data set I have. Small remodel jobs can take from 5 to 15 days while very large ones can be expected to take months. It is clear though that the opportunity cost of remodeling is inversely related to the net benefit. Meaning the higher the opportunity cost the lower the net benefit.

Moving to a new residence is also not cost free. Much time is spent searching for a convergence of buyers and sellers tastes. Sometimes a home searcher will find it nearly impossible to find a home that matches their needs. Remodeling is an alterative to a custom built house for these homeowners. A case like this would make the cost of moving so extraordinarily high that it would trump any other factors that dissuade the homeowner from a remodel. Real estate agent and moving company fees also add to the transaction costs associated with moving. Moving company and agent fees are usually known explicitly. The time spent searching for a home is a harder cost to gauge. All of these costs add to the net benefit of remodeling. The transaction costs make it more expensive to undertake the alternative to remodeling.

Along with a cost to moving there is a benefit to not moving. The benefit to not moving can be thought of as an attachment to a neighborhood or location. It could be that the school district in a homeowner's current area is exceptional. Another possibility the homeowner lives in a close knit community. Benefits of not moving serve to make remodeling a more attractive option.

The final and most important factor in the net benefit to remodel is the non-monetary benefits of the remodel. The non-monetary benefit of the remodel can be thought of as the enjoyment that the remodel brings to the homeowner. These non-monetary benefits arise from differentiated tastes of homeowners. Homeowners will gain

benefits from remodel jobs that are tailored to meet their needs and tastes.[2] An example would be the family that has six kids and only three bathrooms. The family may decide to add a bathroom. Most likely the bathroom would have low or negative net market returns. Benefits would come from the reduced wait for restroom time and lower family tensions.

The extreme example of non-monetary benefits would be a remodel that not only has negative net returns but also detracts from the value of the home. An eccentric homeowner may want to come closer to nature by getting rid of their indoor bathroom facilities. No doubt homes that do not have indoor bathrooms are less valuable on the market than ones that do. The eccentric homeowner is very pleased by their new connection to nature but their house has become significantly less saleable.

The non-monetary benefits are likely to diminish over time. Remodel work wears out just like any other good. The bathroom in the previous example will slowly deteriorate until it is of no use to the family. Another possibility is the six children will begin to grow up and move away lessening the burden on bathroom facilities. The extra bathroom becomes less beneficial as the demand for the bathroom decreases. Future reductions in the consumption of benefits suggest that many homeowners' will not enjoy the full non-monetary benefits of the remodel. If a potential remodeler expects that the will live in the home for only half of the usable life of the remodel they would expect to only a little more than garner half of the benefits. [3]

Equation one brings all the factors that determine the Net benefit of remodeling.

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[2] Non-Monetary benefits should really be referred to as idiosyncratic non-monetary benefits. The benefits come from the gains that an individual get from the personalization of the remodel. These gains are not necessarily reflected in the market value.

[3] A distinction should be made between public and private depreciation of remodeling benefits. Private depreciation is the loss in consumption by the homeowner. The family that has its children move away loses some benefits that the extra bathroom gave. Public depreciation refers to the changes in style and overall wear on the remodel. A remodel built with 1970's style does not give the same benefits in 2003.

(1) NB = R – OPC + TCM + BNM + BR

NB= Net Benefit

R= Net Returns judged by market value

OPC= Opportunity Cost of remodeling

TCM= Transaction cost of moving

BNM= Benefits from not moving

BR= Non-Monetary Benefits from the remodel.

The plus or minus sign in front of the equation shows how the variables are related to the Net Benefit. Unfortunately, the variables are very hard to measure correctly. Transaction costs and benefits of not moving would be highly individualized to each situation. Opportunity cost can be more accurately measured by the loss of implied rent while parts of the home are under renovation. The problem is the loss of home use is specific to the type of job done to the home. There wasn't enough data or will to estimate the loss of implied rent for every remodeled home. What this paper wants to focus on is the non-monetary benefits of remodeling and the net returns. It should be that the existence of non-monetary benefits will help explain the occurrence of negative net returns.

Remodeling's non-monetary benefits can not be measured directly. A survey that compiles homeowner's expressed beliefs about the benefits that their remodels gave them could be constructed. For reasons of reliability this option wasn't used. Non-monetary benefits can be estimated indirectly though. Non-monetary benefits should be a function of how long the homeowner expects to be in their current residence. Longer expectations will allow the remodeler to enjoy more of the benefit of the remodel.

Non-monetary benefits should be a positive function of expected length of residence. Equation two shows Net Benefits equaling Returns plus some function of the time horizons.[4]

$$(2)\ NB = R + f(EL)$$
$$+$$

EL = Expected length of residence

R= Returns

How would equation two manifest itself in real life? Let's imagine two families that have just acquired their second child. They have two bedroom homes in the same development tract. The only difference between the families is type of employment. One family's income comes from a lawyer, while the other comes from an employee at IBM. The employee at IBM knows that her company is famous for transferring workers. The lawyer would incur considerable costs in qualifying for the bar in another state.

The arrival of the new child makes both families current accommodations obsolete. Our families will read the newest edition of Remodeling Magazine and see that adding a bedroom has negative net returns. The Lawyer's family will have an expectation that they will be able to enjoy the benefits of the remodel longer than the IBM employee. These longer expectations will allow the net benefits to the lawyer's family to be higher than their counterparts. A lawyer's family is much more likely to do an eccentric or highly personalized remodel. The IBM employee's family may still wish to do a remodel but they will tailor it in such a way to garner the most net returns from the market. Most likely they will defer changing the characteristics of their residence until they move.

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[4] See Baum and Hassan 1999 for a discussion of what demographic characteristics home renovators share. It could be that certain demographic groups consistently have different time horizons.

II a. Speculative Remodels

Up to this point the assumption has been that all remodels are for benefit of the homeowner. It should be mentioned that some remodels are done only for profit. These remodels will be dubbed speculative remodels. Speculative remodels are done by owners who intend to sell quickly. Speculators will attempt to perform remodel jobs that will maximize the net market returns. The speculative remodel differs from a regular remodel because non-monetary benefits are unimportant.

R in equation one and two is the only variable that matters to a speculator. Speculative remodelers would have effective expectations of zero. Net Benefits would rely solely on net market returns for a speculative renovator.

Speculators would only care about receiving the highest returns from their investment. Only factors that go into deciding net returns are important. Net Returns should be a function of cost and type of job. Higher costs will negatively affect the net benefit and types of jobs will have an ambiguous effect. The speculative remodeler will be able to read Remodeling magazine to decide which types of jobs will return the most. The net benefit equation would look like 1 A.

(1 A.) NB = R (Cost, type of job)

Overall it can be said that remodels done for profit will be suited to market tastes instead of an individual's tastes. Also, speculative remodels should sell relatively quickly compared to their counterparts. Relatively fast sales can skew the expected length of residence of remodelers as a group. If they are not identified they can shorten the expected length of residence of normal renovators in the data sets.

III. Tests of Theory

The model presented seems to make logical sense. However, the model would be rather weak without data to support its suggestions. Tests need to be designed to substantiate the claims made by the theory.

The first claim made in Realtor magazine is many home remodel jobs add less market value than they cost. To test this it will have to be determined how much a home remodel job costs and how much value is added. The costs of remodel jobs can be determined from building permits from the city of Seattle. The value added is determined by looking at a home's assessment before the remodel takes place and then again after the remodel takes place. The difference can be thought of as the value added by the remodel. The remodels are separated into two groups. The groups are additions and interior remodels. Only two groups were chosen because of the high marginal cost of extracting data. The difference in these groups can be thought of as one adds space to the home while the other beautifies and upgrades it.

Time horizons are crucial is determining which homeowners are more likely to remodel. The test of this proposition can be thought of as analogous to an observational medical study.

Suppose there is a disease that causes reduced lung capacity. Doctors would try to come up with a measure of lung capacity. Imagine they decide that the decibel a person can reach when yelling is a good measure. Researchers would then compare patients by matching various characteristics like age length of time since infection etc. (Assuming a random sample is not possible). Yelling ability would then be measured to observe which patient characteristics are most likely to suffer from an inability to yell.

This paper's tests follow the same basic pattern as the hypothetical medical observation. People who have information that they will reside at their homes for many years will have higher net benefits. The measure of homeowners' expectations of length of stay in their residence will be the time elapsed between the start of the remodel and the sale of the home. The longer it takes for a home to sell is a sign of longer expectations. Remodeling is analogous to the different characteristics of the patients. Hopefully, homes that have been remodel will take more time sell than non-remodeled homes. This result will be a signal that homeowner's who remodel expect to live in their homes for some time.

Equation two says that a homeowner will gain more of the non-monetary benefits of a remodel the longer they expect to stay in their current residence (equation two is reproduced below). This implies that the remolded homes that sell quickly will have to have larger net market returns to keep the net benefits positive. A regression of net returns and years to sale of remodeled homes can help test this implication. I predict that as years to sale of remodel homes go down their net market returns go up.

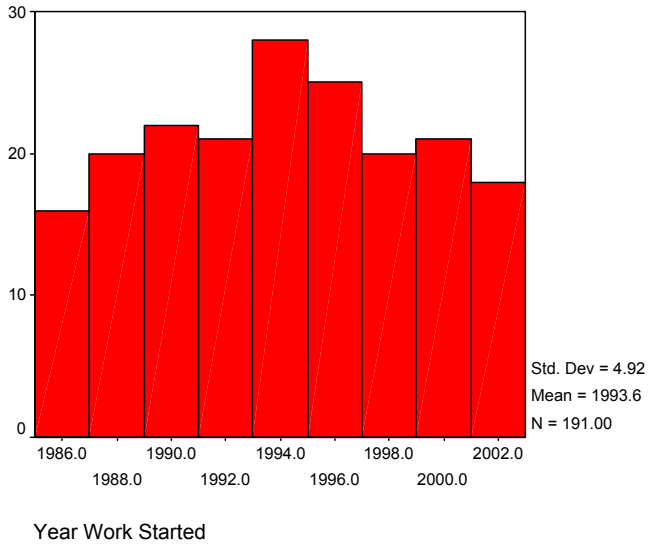
(2) $NB = R + f(EL)$

A major problem arises when trying to compare remodeled home sales to non-remodeled home sales. The remodel jobs were not undertaken all in the same year. This causes a problem of truncation. Homes with relatively recent remodels will have less of a chance to sell. A comparison of these newly remodeled homes with non-remodeled homes from a base year would yield a difference based upon the different amount of time the homes had to sell rather than the different probabilities of sales that remodel homes and homes that were left alone possess.

The solution to this problem is to match the remodeled homes with a non-remodeled home from the same year. The homes are also matched by value and neighborhood. A home that was remodeled in a particular year is matched to a home with a similar value from the same neighborhood and in the year when remodeling was done. The distribution of remodeled homes and matched non-remodeled homes are shown in figure one.

This test will use building permit information from the city of Seattle and Everett. The Everett permits were not used to determine value added because the Snohomish county assessor only keeps assessment records from five years back. The Everett data is useful in telling whether the home sold or not.

Figure 1
Distribution of remodeled Homes by Year Remodeled
Homes from Seattle



IV. Testing Methods and Data

Testing empirical evidence from the real world is often times complicated by the presence of various phenomena. Various types of inflation have to be dealt with. The nominal costs of a remodel need to be transformed into real dollars. This is important because the analysis contains remodels from different points in time. This means that the cost of remodels will be subject to the forces of inflation. Costs will have to be adjusted to real terms by an index. The easiest index to use would be the Consumer Price Index. However, a more precise index comes from the construction materials part of the Producer Price Index. This will provide a more accurate view of how much the price of inputs into the remodel process have changed over time.

The other major problem arises from the presence of housing inflation. Housing inflation is the upward trend in prices for a constant-quality home. Without housing inflation the test for determining the value added by a remodel job would be as simple as described earlier. The value before the remodel would just be subtracted from the value after the remodel and that would be the value added. However, since housing inflation is present a method for dealing with the problem has to be devised.

One method of deflating home prices was put forth by Robert Shiller (Shiller 1990). His method uses repeat sales of the same unchanged home to determine how prices have moved. An index is then created using this information. The index would look like equation three:

$$(3)\quad \text{Index} = \frac{Pa2 + Pb2 + Pc2}{Pa1 + Pb1 + Pc1} \times 100$$

P1 = price of a home in period 1

P2 = price of a home in period 2.

One problem with the Shiller method is it restricts the sample by first eliminating homes that have changed over time and then eliminating homes that have only sold once. Shiller can do this because there are enough non-remodeled homes that sell twice to give him a good sample. To be used in the index that I created homes would have to sell once before the remodel and then again after the remodel. Only twenty houses in my data set meet this criterion.

The Shiller method will be used in this paper but it will be modified somewhat. I will use assessments rather than sales. This is done to enlarge the sample of remodeled homes. Assessments on the other hand are available for every home. They also have the advantage of being conducted every year or every other year in some cases. More data points are provided for the index. The method is basically the same except for homes that have been remodeled are not included in the assessment index. This is because the whole point is to construct an index that measures the price increases of a constant-quality home. The index will be known as the assessment Shiller index.

IVa. Indexes

The assessment Shiller indexes are crucial to this paper's final goals. The indexes provide a way for the value of homes to be deflated into real terms. A discussion of how their reliability and why two different indexes are used is called for.

The remodels studied in this paper conform to three areas the assessor uses in Seattle. For each area I constructed two different indexes. One index measures the rise in

the value of total assessments. The other measures the rise in the Improvements to the Land. The improvement to the land is the intuitive measure. The remodels in this paper only effect improvement values. Land is also the more volatile part of the assessments because its supply is almost totally fixed. Figure two and three show two simple cases where the supply of Land is perfectly inelastic while the supply of Improvements is perfectly elastic. Obviously, this isn't a perfect representation of reality. Effective land can be increased through drainage of swamps or building of highways. Improvements are limited by zoning restrictions. Table 1 shows the correlations between all three improvement indexes and three Land indexes for the same area. Improvements should be more correlated with each other as opposed to Land if improvements behave like figure 3. Most of the improvements are not as correlated with land as they are with the other improvements indexes. Equations four through six show regressions with the land index as a function of the Improvements index. In two of the three areas the coefficient on the improvement index is less than one. This suggests that land prices were rising more rapidly than improvements prices.

Table 1
Correlations between Land and Improvements Indexes

Correlations

		IMP1	IMP2	IMP3	LAND1	LAND2	LAND3
IMP1	Pearson Correlation	1	.964**	.954**	.968**	.693**	.902**
	Sig. (2-tailed)	.	.000	.000	.000	.006	.000
	N	14	14	14	14	14	14
IMP2	Pearson Correlation	.964**	1	.979**	.945**	.538*	.874**
	Sig. (2-tailed)	.000	.	.000	.000	.047	.000
	N	14	14	14	14	14	14
IMP3	Pearson Correlation	.954**	.979**	1	.913**	.520	.823**
	Sig. (2-tailed)	.000	.000	.	.000	.056	.000
	N	14	14	14	14	14	14
LAND1	Pearson Correlation	.968**	.945**	.913**	1	.723**	.968**
	Sig. (2-tailed)	.000	.000	.000	.	.003	.000
	N	14	14	14	14	14	14
LAND2	Pearson Correlation	.693**	.538*	.520	.723**	1	.806**
	Sig. (2-tailed)	.006	.047	.056	.003	.	.000
	N	14	14	14	14	14	14
LAND3	Pearson Correlation	.902**	.874**	.823**	.968**	.806**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.
	N	14	14	14	14	14	14

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

(4) Area 1: LI = .603 + .812 Imp
(9.706) (.061)
Standard errors of the coefficient.
R^2=.936

(5) Area 2: LI = -39.376 + 1.414 Imp
(38.285) (.268)
Standard errors of the coefficient.
R^2= .777

(6) Area 3: LI = 13.178 + .695 Imp
(52.314) (.257)
Standard errors of the coefficient.
R^2= .477

LI = Land Index
Imp = Improvement Index

Figure 2

A Perfectly Inelastic Supply of Land

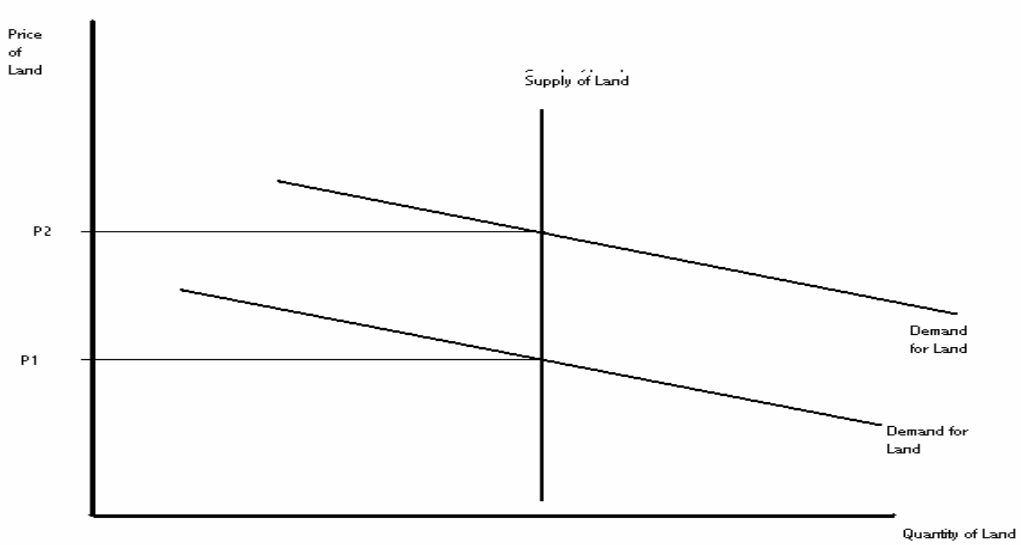
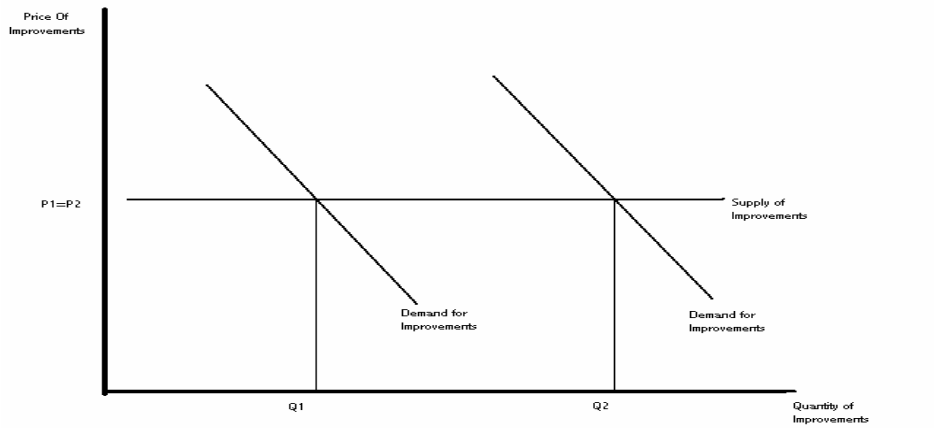


Figure 3

Perfectly Elastic Supply of Improvements



The Improvement index provides the more appropriate measure. However, the total value index is the more precise number. The assessment process uses recent sales to determine the market value of land and the structures that sit upon it. This is an accurate method when dealing with total values of properties because many sales are observed. The problem is sales of improvements minus the land are rare and in built up areas sales of vacant land are almost as rare. This leads us to be somewhat suspicious of the improvement value numbers. The improvements also lack the adjustment mechanism provided by people complaining about the value of their assessments. Not many homeowners complain about the distribution of assessment value between the land and the improvements.[5]

In the end the improvements index and the total value index move in close harmony. Figures four graphs the movements of all the indexes for each area. They seem to move in lockstep. Figure five actually lists the index numbers for each area. Once again they move in similar direction.

[5] People would be more apt to complain about the distribution of value between land and improvements if they were taxed at different rates. Unfortunately, for us the state of Washington doesn't do this.

Figure 4

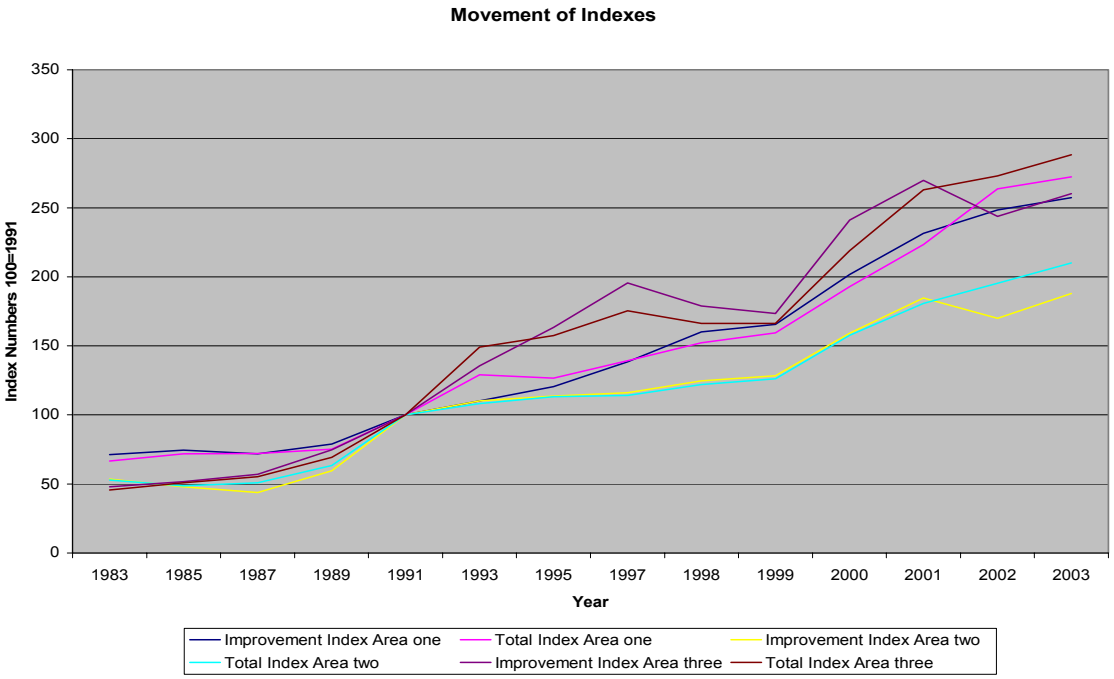


Figure 5

Indexes 1991=100

Year	Imp 1	Imp 2	Imp 3	Tot 1	Tot 2	Tot 3	Land1	Land2	Land3
1983	71.23	53.36	47.97	66.67	52.71	45.59	51.63	114.66	58.69
1985	74.36	47.87	51.61	71.91	48.59	50.87	50.61	183.86	76.7
1987	71.92	43.74	56.96	71.96	50.71	55.19	58.61	149.92	63.4
1989	78.89	59.58	74.63	75.02	63.30	69.15	66.43	141.50	71.67
1991	100	100	100	100	100	100	100	100	100
1993	110.26	110.19	135.47	128.95	108.27	149.07	108.55	139.96	147.22
1995	120.5	113.61	163.36	126.53	113.34	157.56	109.17	126.33	115.29
1997	138.32	116.03	195.48	139.39	114.12	175.52	111.32	119.17	104.22
1998	160.00	124.67	179.05	152.26	122	166.17	119.41	125.91	106.34
1999	165.58	128.29	173.41	159.49	126.07	166.23	120.79	139.44	115.68
2000	201.74	159.19	241.16	192.93	157.59	219.09	143.19	156.36	138.91
2001	231.59	184.66	269.80	223.42	180.71	263.10	171.39	185.81	171.58
2002	248.38	170.06	243.68	263.62	195.35	273.05	220.8	245.09	237.02
2003	257.29	187.84	260.24	272.43	210.06	288.48	225.87	250.32	259.30

IVb Assessments

Assessments serve as another major measure in this paper. The assessments serve as estimates for the values of the homes. Washington state law requires that homes be assessed at their full market value. It is still important that all doubts about their creditability are removed. Explaining why they are used and the assessment process could be valuable in understanding the relationship between the assessment value of a home and the market value. As we shall see assessments should also be deemed efficient and reasonable predictors of home sale prices.

The housing market presents strong barriers to estimating value of existing structures. One is the fact that only a small number of homes sell in a given year. The other is houses are heterogeneous. Assessments are used to solve both of these problems. The assessments judge the change in value in homes of constant quality. These serve as the baseline for the index. Assessments also serve as stand-ins for the change in market value brought about by a remodel. Not every home sells in the time period that is study. In fact, the contention is remodeled homes will sell quite infrequently. Assessments allow for every home whether sold or not to have a measure of market value.

Assessments also seem to help solve a problem of causation. Let's imagine we had used sale price as a measure of value and found that remodeled homes that sell quickly have higher market returns than those that take a longer time. A skeptic may say remodeled homes that sell quickly have higher market returns because they have newer remodel jobs with less time to depreciate. Assessments solve this problem because all the assessment values were taken at the same length of time since the remodel. The construction of assessments is vital and should be well understood.

Hedonic regressions explaining sale price in terms of different features of each home sold and a survey of home characteristics serve as the building blocks for assessments. Each property is assigned an assessment equal to the value that a regression estimates a home with its characteristics would sell for.

One of the models used in assessing properties is presented below (The actual model is attached in Appendix A2). The model explained here is for South Beacon Hill. The first model that is created for the property is called the Land model. It estimates the price of the land without the buildings on it. Area 79 is broken down into 4 sub-areas labeled A, B, C, and D. A regression is run on each area's sales to determine the value of empty plots. However, the relative lack of sales limits its role. The assessor does not explicitly state the regression in their summary reports. Instead, the assessor uses the vacant land sales to help develop various adjustments to the market land value. Individual appraisers then use their judgment to determine how common characteristics adjust the land value.

The appraiser starts with a baseline value for the land that depends upon square footage. Baseline land value ranges from $175 for a 250 sq. ft plot to $138000 for a 45000 sq. ft plot. The appraiser then uses their judgment to adjust the baseline land value depending on topography, traffic noise, and view. A view judged excellent by an appraiser adds 40% to the value of the land. Traffic noise and topography both detract from the value of the land. The appraiser can drop the value of the land between 5% and 90% depending on how extreme each problem is.

The value of the land is not the only part of the assessment that needs to be determined. The values of the buildings also affect the final assessment. The building's

values are determined in much the same way as the land value. Characteristics are assigned to each home that represents variables that influence the final sale price. Thirteen variables are used altogether. All of them are listed in the appendix. Most of the variables have to do with actual physical features of the home. For example, the assessor measures how many bedrooms and bathrooms the home has. Other variables are more subjective. The building grade variable is assigned by the appraiser using an established scale.

A regression is then run using good sales to determine how much each variable affects the final sale price. Good sales should be conducted at market prices. A good sale isn't a transfer between family members or part of a divorce settlement. It is up to the assessor's office to use solid judgment in determining what a good sale is. The only constraint for the assessor is to have enough good sales to make a regression. He needs to divide the county into large enough neighborhoods that yield enough sales. However, the assessor doesn't want to create neighborhoods that are so large that the homes have few variables in common. The division of neighborhoods into units that produce enough good sales is purely at the assessor's discretion. Knowing the assessment process is not enough. The process should also be deemed a creditable and efficient way to value a home.

Levis Kochin and Richard Parks give a framework for thinking about the efficiency of assessments (Kochin and Parks 1982). Kochin and Parks call an assessment efficient if it is not possible to improve the assessment without more information. To test the efficiency of the assessments they propose regression equation seven:

$$(7)\ A/S = \beta + \beta 1A + \eta$$

Where A/S is the assessment to sale price ratio and A is the assessment. β=0 is considered a fair and efficient assessment. The slope of zero means that the assessor isn't consistently biased towards homes of different values. Kochin and Parks end up endorsing the assessment method as efficient and reasonable.

The Kochin and Parks regression is used to test the efficiency of assessments in 2001. Equation 8 shows the regression. Equation 8a is the results from Kochin and Parks. The results are very similar to what Kochin and Parks found. Almost all aspects of the test are exactly the same as when they ran their test. The assessments and sales are both from King County. The assessment process is virtually identical to the process used when they conducted their research. The only differences are this test is being conducted twenty years after the Kochin and Parks' test and this test uses a smaller section of King county to draw its data.

2002

(8) A/S = .987 + .000001036A
(.161) (.000)
Standard errors of the coefficient.
R^2= .008

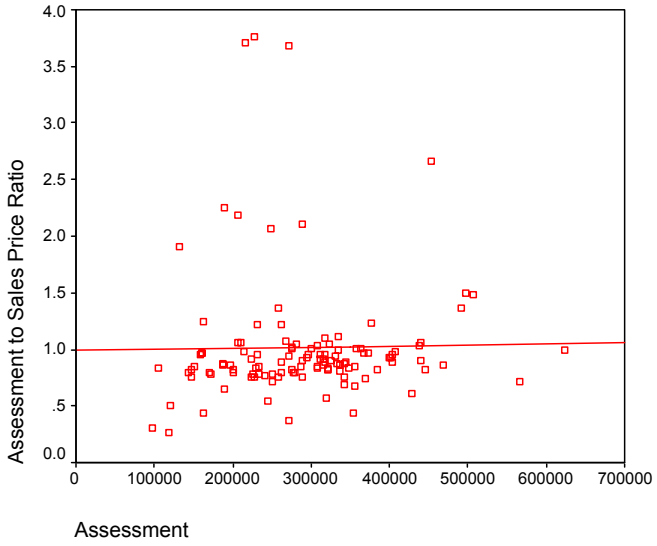
Kochin and Parks 1982

(8)a A/S = .5556 + .00000038288A
(.0203) (.0000009506)
Standard errors of the coefficient.
R^2= .0004

It should be no surprise that the regression yields results similar to Kochin and Parks' research. They report a slope that is just as minuscule as the one in equation eight. Their standard errors are a bit smaller. Kochin and Parks' reported R squared is smaller than equation 8. Except for these slight differences the results are almost identical to what Kochin and Parks found twenty years ago. Equation eight suggests that the 2001 assessments should be deemed efficient just as the assessments twenty years ago were.

Figure 6

Assessment Ratio vs. Assessment using Data from the Skyway, Wallingford, and South Beacon Hill neighborhoods of Seattle



The other important function of an assessment is its predictability factor. The assessments would be of little value to us if they were efficient but could not predict anything. The assessments would be a perfect predictor of sales price if a regression was run and the assessments had a slope of one. This would mean for every extra dollar in assessments the sale price of the home would go up by exactly one dollar. The results of a regression like this on sales from the 2001 is shown is equation 8b. Equation 8 c is what Kochin and Parks found.

2002

(8b) S= 59120.378+ .921A
(30188.227) (.098)
Standard errors of the coefficients.
R^2= .428

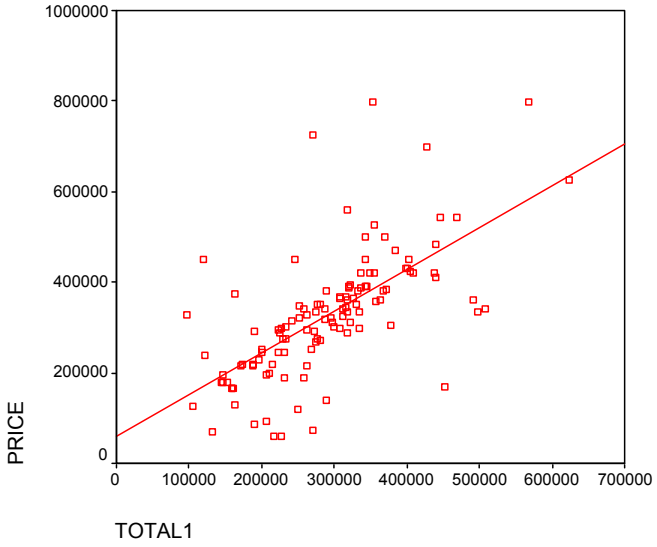
Kochin and Parks 1982

(8c) log S = .8775 + .9720 log A
(.3432) (.0347)
Standard errors of the coefficients.
R^2 = .6538

S = Sale Price
A = Assessment

Figure 7

Sales Price vs. Total Assessment Value Data from Skyway, Wallingford and South Beacon Hill neighborhoods of Seattle



The slope is not exactly one. The assessor seems to be off in predicting the exact sales price of a home. The coefficient is very close to one though. This suggests that the assessor seems to do a fairly good job of predicting market value. The discrepancy between what the market thinks the value of a house is and what the assessor thinks can be chalked up to human error and unobserved variables. The assessment process described earlier showed that the assessor only uses thirteen variables. Surely, there are features that an assessor will fail to take into account when appraising the home. An unseen infestation of ants would go unrecorded by the assessor. However, the market would surely notice and penalize the home. A phenomenon like this could help explain the outliers in figure seven.

V. Estimating the Remodeling Model

The main assertions that were made earlier in the paper suggested that many home remodel projects actually have negative net returns. The quandary that arises is why anyone would engage in remodels that have consistently negative returns. If net returns were the deciding factor in remodels we'd expect only to see remodels that add more than they cost. However, the charts below show that some remodels return little or are a losing proposition. Figure eight shows net returns on all remodels. Additions are shown in figure nine. Interior alterations are presented in figure ten.
They are accompanied by the distributions. Equation nine gives the definition of net returns.

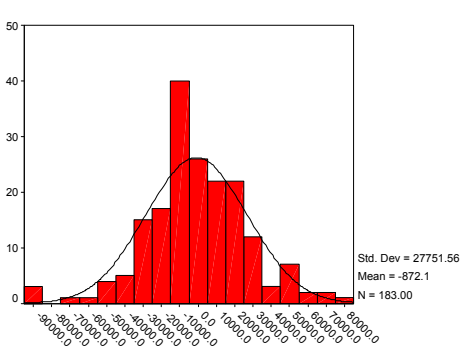
(9) Net Returns= Value Added – Real Cost

Figure 8

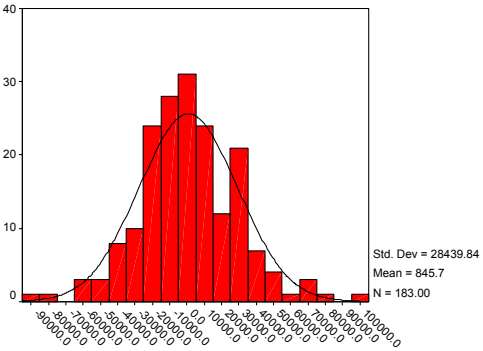
Net Returns on All Remodel Projects

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Net Returns using Improvements Imdex	183	-94056.60	79395.53	-872.1152	27751.55695
Net Returns using Total Land Value Index	183	-88854.04	96384.73	845.7479	28439.84362
Valid N (listwise)	183				



Net Returns using Improvements Imdex



Net Returns using Total Land Value Index

Table 2

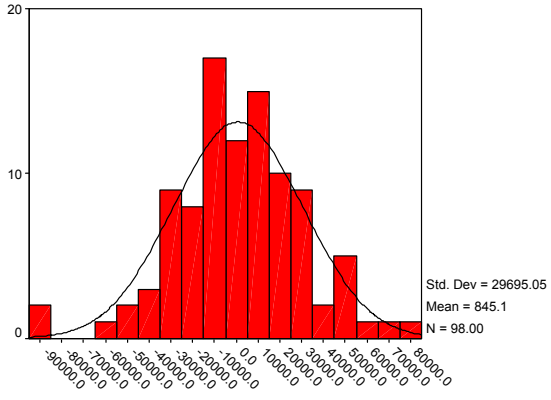
Net Returns on Additions using Improvements and Total Land Value Indexes

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Net Returns using Improvements Imdex	98	-94056.60	79395.53	845.0819	29695.05121
Net Returns using Total Land Value Index	98	-88854.04	77681.86	3202.2983	30694.90663
Valid N (listwise)	98				

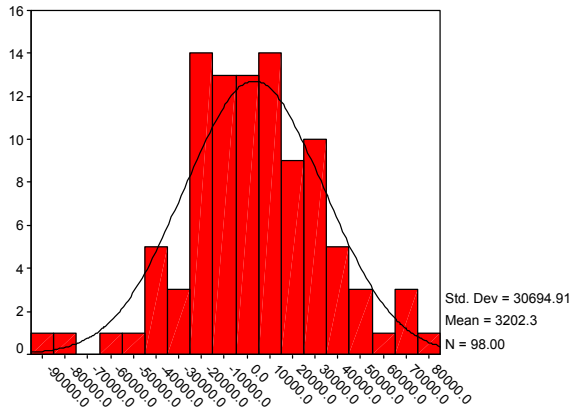
Figure 9a

Distribution of Net Returns to Additions using Improvements Index



Net Returns using Improvements Imdex

Figure 9b
Distribution of Net Returns to Additions using Total Value Index



Net Returns using Total Land Value Index

Table 2
Net returns on Interior Alterations using Improvements and Total Value Indexes

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Net Returns using Improvements Imdex	85	-85948.07	70545.60	-2851.94	25357.14627
Net Returns using Total Land Value Index	85	-63822.90	96384.73	-1871.22	25505.18425
Valid N (listwise)	85				

Figure 10a
Distribution of Net Returns to Interior Alterations using Improvements Index

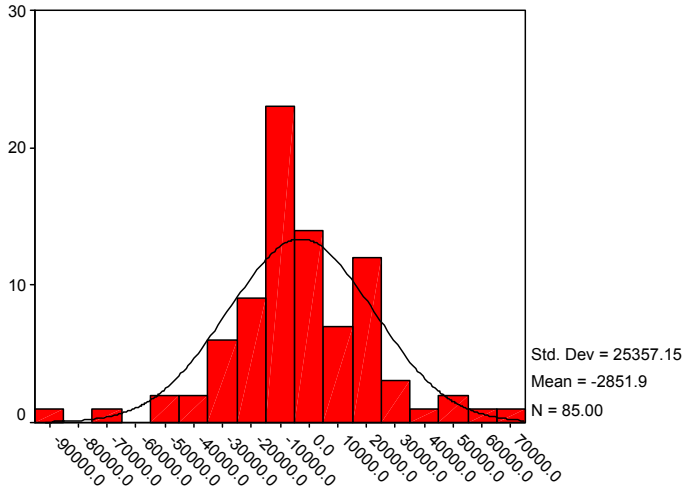
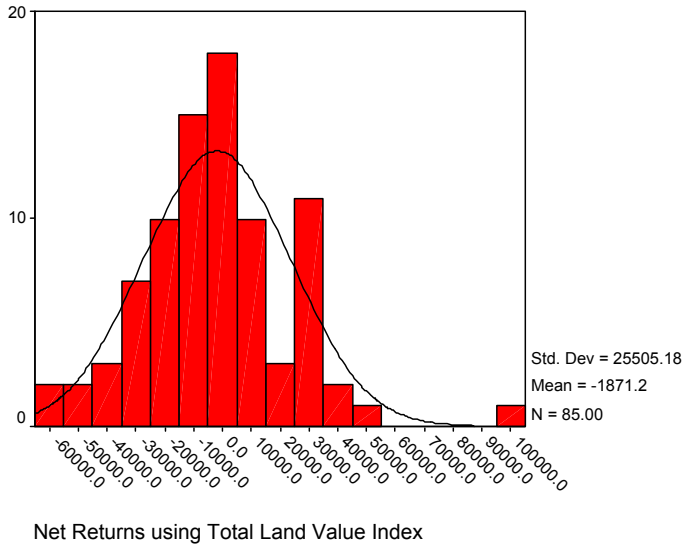


Figure 10b
Distribution of Net Returns to Interior Alterations using Total Value Index



The data seems to suggest that interior alterations return negative amounts while additions return positive amounts. The additions are very close to zero though. T eight shows a t-test to decipher whether the difference is attributable to random chance.

Table 3

T-test of mean difference between net returns on Additions and Interior Alterations

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Net Returns using Improvements Imde	Equal variance assumed	2.484	.117	.898	181	.370	3697.0243	4115.4830	-4423.47	11817.52
	Equal variance not assumed			.908	180.961	.365	3697.0243	4069.6986	-4333.14	11727.19
Net Returns using Total Land Value Inc	Equal variance assumed	3.104	.080	1.205	181	.230	5073.5144	4210.0898	-3233.65	13380.68
	Equal variance not assumed			1.221	180.684	.224	5073.5144	4155.3778	-3125.80	13272.82

The t-test has a low significance level. This means that it can not be said definitely that additions return more or less than interior alterations. It can be said that a large portion of the cases studied have negative market returns. This would suggest the Realtor magazine isn't crazy when it lists that most home remodels have negative net returns. Also, there is probably something else determining the remodels besides return on investment

Determining which type of remodel job returns more only fulfills one of our goals. The main question that was going to be solved was what drives a homeowner to remodel. The suggestion put forth before was that time horizons are an important determining factor. The story goes that if a homeowner has longer time horizons and more of an attachment to the community the non-visible costs of moving would be higher. The homeowner would also have more time to enjoy the benefits of the remodel. However, it was recognized that not all remodels are done for the consumptive benefit of the homeowner. There are a

number of people who attempt to profit off remodeling by buying a home where a remodel would add tremendously to the value and then selling after the remodel was completed. These remodels were dubbed speculative remodels.

The best way to determine a homeowner's time horizon would be to look into each individual's mind and determine what their perceived attachment to their current living conditions are. I use sales of remodeled homes versus non-remodeled homes. My expectation is remodeled homes do not sell very often. This would be because homeowner's would have reasonable information about their attachment to their current residence and would only engage in a remodel if they planned to stay for a sufficient amount of time.

Figure eleven shows the frequency of remodeled home sales. A comparison of sales patterns of remodeled and non-remodeled homes is pictured in figure twelve. Table four the distribution of remodels measured by the time between the sale of a home and the start of the remodel. The next chart plots the sales of remodeled and non-remodeled homes. They are measured as percentage sold each year out of the total possible homes.

Decreasing sale possibilities is a feature of the matched sample. This is done because not all remodels took place in the same year. As the years go on fewer homes have a chance to sell. The data starts one year after the remodel. All homes have the possibility of selling. Two years after the remodel only homes remodeled in 2001 or before are counted in the sample. This goes on until year 18 where only homes remodeled in 1985 are counted (every remodeled home has a non-remodeled home matched to it).

The results show that remodeled homes sell at a slower pace than non-remodeled homes at the beginning. Substantially more of the non-remodeled homes also sold across the observed time period. This suggests that people remodel tend to have expectations of longer time horizons. The results are right in line with what the theory would predict. The only concern comes from the distribution of the remodeled homes that did sell. Most of the remodeled homes that did sell sold relatively quickly after the remodel. The occurrence these homes suggests that some remodelers have short time horizons.

Table 4

Remodeled Home Sales

Statistics

YRSOLD

N	Valid	183
	Missing	0

YRSOLD

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no sale	145	79.2	79.2	79.2
	1.00	6	3.3	3.3	82.5
	2.00	3	1.6	1.6	84.2
	3.00	6	3.3	3.3	87.4
	4.00	4	2.2	2.2	89.6
	5.00	4	2.2	2.2	91.8
	6.00	2	1.1	1.1	92.9
	7.00	4	2.2	2.2	95.1
	8.00	1	.5	.5	95.6
	9.00	3	1.6	1.6	97.3
	11.00	1	.5	.5	97.8
	13.00	3	1.6	1.6	99.5
	14.00	1	.5	.5	100.0
	Total	183	100.0	100.0	

Figure 11

Sales of Remolded Homes by Year

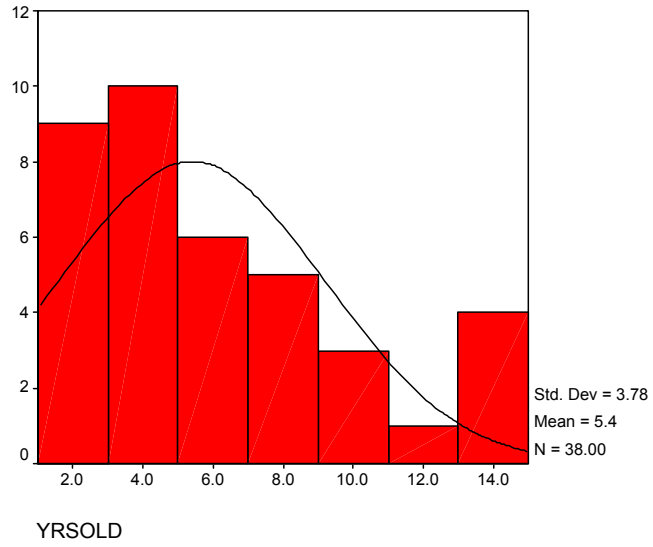
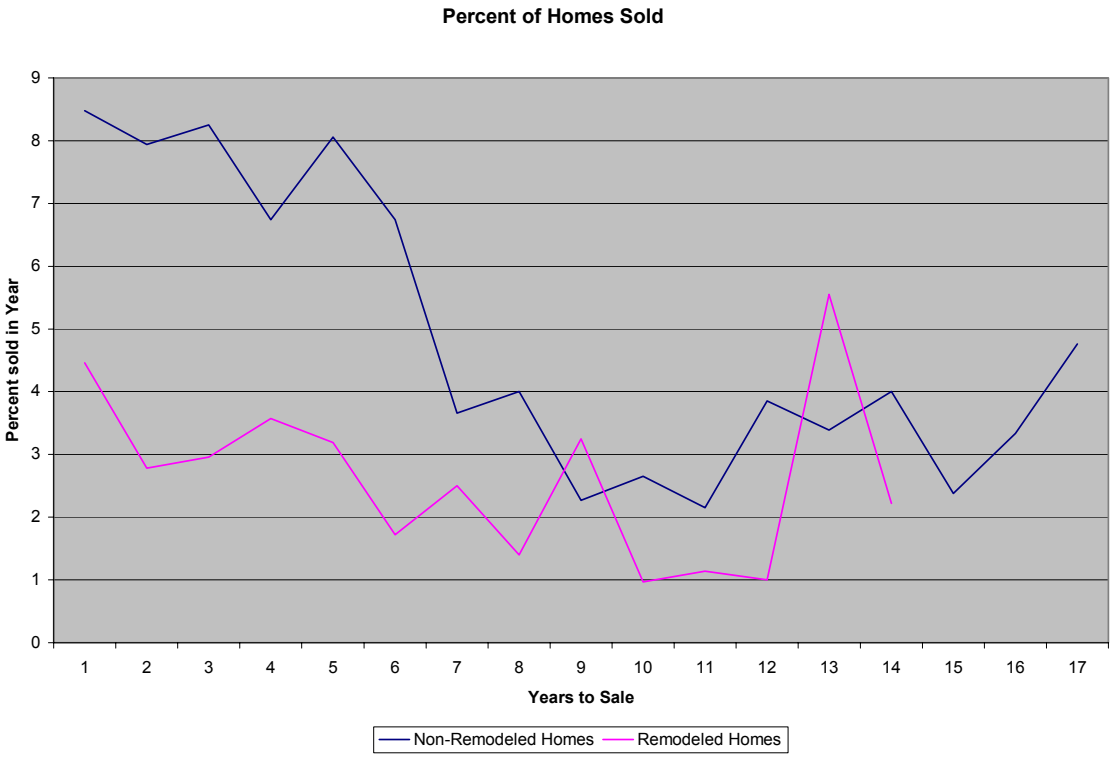


Figure 12



Speculative remodels explain the sharp spike in sales right after the remodel. The goal of a speculative remodeler is to maximize profits and minimize inventory costs. The occurrence of speculative remodels changes the expectations about the observed sales patterns. Without speculative remodels remodeled homes would sell more slowly. The speculative remodels would cause a concentration of sales soon after the remodel along with the concentration in the future. This is exactly what is observed. One question lingers. Is there a way to show that the first concentration of sales are likely speculative?

One way to do this is to look at our return measurements. The whole point of speculative remodels is to have a positive return on the investment. It should be that these homes that were sold shortly after being remodeled have higher returns.

A t-test determines the likelihood that the observed difference in the means is driven by randomness. Table five is a t-test of the difference between the average percent returned on remodel projects from homes that sold and homes that did not. Average percent returned is used here because it is easier to see the difference and it helps control for the size of the remodel. Using the improvements index there is a 4.2 percent chance that the observed difference is due to chance alone. A significance level of 5 percent is the standard amount tolerated. The low significance levels lend credence to the idea that homes that sold have higher returns than those that weren't sold.

Table five is crucial evidence in support of the notion that homeowners with longer time horizons will generally undertake remodels that have lower returns. The table should be explained fully to resolve any confusion. The significance level is listed in the fifth column. One may notice that both index measures only pass the test if equal variance is assumed. The Levene test for equality of variances is listed in the first two columns. Levine's test helps determine whether equal variances should be assumed. The second column shows the significance level of the Levene's test. The significance level works much the same way as testing the equality of the means. The difference is with a significance level of less than 5 percent the data is considered to be

homogenous with respect to variation. Using both indexes the significance level is less than 5 percent. This would lead us to believe that equal variances should be assumed.

Table 5
Mean Difference of Net returns as a percentage of cost from Remodeled Homes that Sold and Remodeled Homes that did not sell measured by assessments

Group Statistics

	If house Sold	N	Mean	Std. Deviation	Std. Error Mean
Percent of Real Cost Returned by Added Value using Improvements Index	Not sold	145	119.3733	193.12170	16.03788
	Sold	38	260.6883	743.95215	120.68498
Percent of Real Cost Returned by Added Value using Total Land Value Index	Not sold	145	115.1857	199.02445	16.52808
	Sold	38	236.6255	577.15402	93.62674

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Percent of Real Cost Returned by Added Value using Improvements Index	Equal variances assumed	11.100	.001	-2.052	181	.042	-141.3149	68.87012	-277.206	-5.42336
	Equal variances not assumed			-1.161	38.315	.253	-141.3149	121.74595	-387.710	105.08029
Percent of Real Cost Returned by Added Value using Total Land Value Index	Equal variances assumed	7.297	.008	-2.111	181	.036	-121.4397	57.51684	-234.929	-7.94996
	Equal variances not assumed			-1.277	39.332	.209	-121.4397	95.07442	-313.694	70.81452

It can be predicted that net market returns measured by assessments should be lower the longer the length of time between remodel and sale. Equation two also says that returns should be highest on remodels with homeowners that do not expect to be in their current residence for long.

Speculative remodels with the higher net financial returns would have the shortest time to sale. Regressions ten and eleven show that years to sale is negatively related to net market returns. Regression ten uses the net returns using the total value index while eleven uses the improvements to land index. Figure thirteen and fourteen show the scatter plots.

(10) R = 15101.61 – 1347.34years to sale
(6959.874) (1043.004)
Standard errors of the coefficient.
R^2 = .074

(11) R= 8212.82 – 1520.29 years to sale
(7807.855) (1170.082)
Standard errors of the coefficient.
R^2 = .059

R= Net Returns

Figure 13
Net Returns using Total Value Index vs. Year Sold

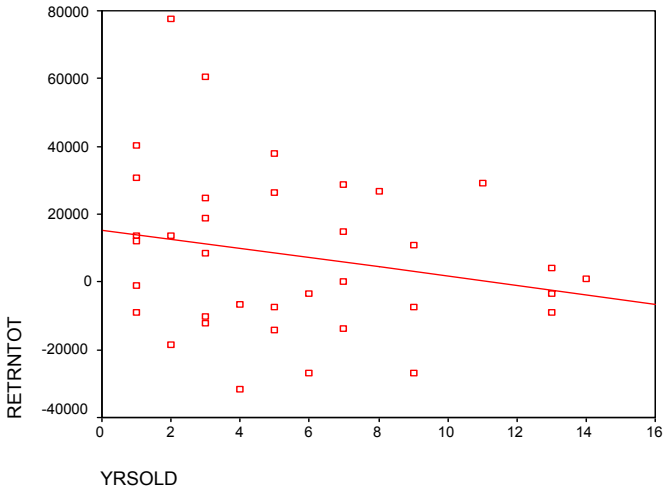
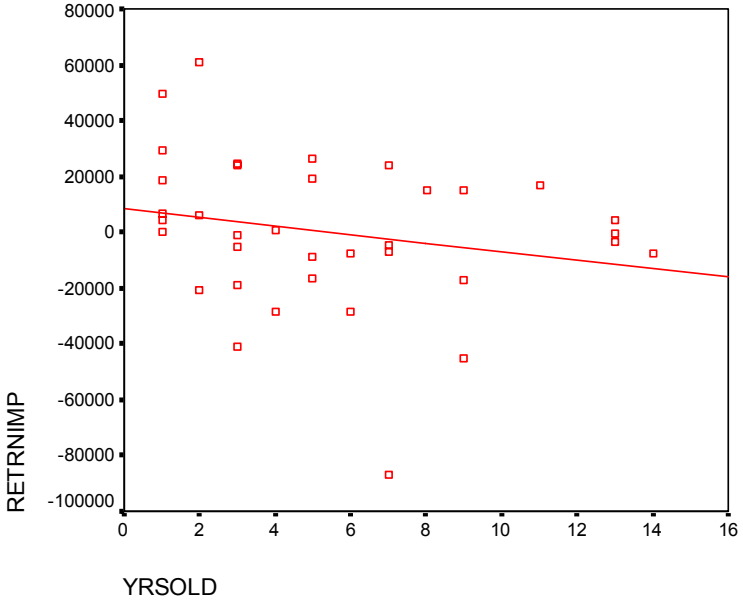


Figure 14
Net Returns using Improvement Index vs. Year Sold



Years to sale represent the time horizons of the homeowner as an occupant. It seems that longer it takes for home to sell the less market return the remodel gives. This is just what was expected. The negative coefficient suggests that longer time horizons cause lower returns. How can this be interpreted by equation two? Homeowner's will only undertake a remodel if the net benefits are positive. Longer time horizons mean that the homeowner expects to enjoy more of the non-monetary benefits of the remodel. Higher non-monetary benefits allow net benefits to be positive while market returns are low or negative. The moral of the story is that a homeowner that expects to be attached to their current residences will be able to undertake projects that have low market returns.

Summary

The home remodel market is one of substantial size. However, the new home sales market seems to dominate the academic literature on residential properties. Many of the studies that have been done on the remodel market have been conducted in the popular press. The popular press is mostly concerned with the net return from a remodeling investment. The puzzle that arises according to their data is most remodels have negative net returns. The consistency of the negative returns suggests that something other than return on investment pushes individuals to remodel.

The other factor that homeowners use to decide whether or not to remodel is the idiosyncratic non-monetary benefits of remodeling. These benefits are hard to predict and measure but their consequences are measurable. Idiosyncratic benefits should be highly correlated with how long an individual expects to live in their current home. The longer a homeowner's expected, the higher their benefits to remodeling will be and they more likely the will be to undertake a remodel.

The empirical evidence is limited in some ways because of the relatively small size of the sample. What can be said from the sample is many home remodels do return negative dollar amounts. Also, remodeled homes tend to sell less often than non-remodeled homes. This suggests homeowners who remodel have longer time horizons. A counterweight to this assertion is the remodeled homes that do sell, tend to do so quickly. These quick sales can be identified as speculative remodels by their higher returns. The evidence isn't as strong on this

point but it does point in the direction of a negative relationship between years to sale and net returns.

The analysis in this paper explores why people remodel or don't remodel. The answers suggest that home improvements are not a good store of value like the original purchase of the home. They are more comparably with a consumer good like a car. The home remodel industry would be wise to market the benefits of remodeling more like an auto dealership would advertise a car. Automobiles' returns come almost exclusively from idiosyncratic benefits like style and taste.

A topic that is left open for further research is the macro side of remodeling. These would be the variables that shift demand for remodels. One obvious one would be interest rates. Increased interest rates usually cause a decrease in demand for most goods. However, lower interest rates may have the exact opposite effect on remodeling. A homeowner who holds a mortgage that is lower than the current market rate could be more likely to remodel. To buy a new home a homeowner would have to give up their current low interest rate for a higher one. A remodel would allow the homeowner to transform their current home to one that fits their needs without having to give up their low rates. This would create a rare instance where the demand for a good is positively related to the interest rate.

Appendix A4

It was suggested that I thank people who have helped me with this project and explain the process I went through to construct the data. I'd like to thank my advisor, Robert Shiller, the Snohomish and King County Assessor's offices, and the building permits department in the cities of Everett and Seattle.

The process of collecting and constructing the data consumed the lion's share of the time spent on this project. My hope was that I could find a locality that actually kept the remodeling statistics that I wanted. Unfortunately, none did. I solved this problem by getting remodeling cases from city building permits. The building permits gave cost and type of remodel. Getting the permits was difficult though. The Seattle Department of Land Use classifies permits on addresses. I had to check address by address to see if a home had any permits on file. Only about 10 percent of the homes had any permits on file.

The building permits did not give any measure for value added. To get this information I went to the assessor's department. Of course, the assessor did not use addresses to categorize its data. I had to transforms the permit addresses into parcel numbers. I did this with the help of several assessors' maps. I then went through each parcel to get the value before the remodel and after the remodel.

The assessments values had to be changed into real terms. I ended up created several different indexes using Robert Shiller's method. Shiller's company was kind enough to give me one index that I used to test the reasonableness of the indexes I built.

In the end the high cost of extracting data put a severe constraint upon what I could actually do. It did turn out to be a good experience in how to manage and construct data though.

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